Next-Generation Real-Time Geodetic Station Sensor Web for Natural Hazards Research and Applications

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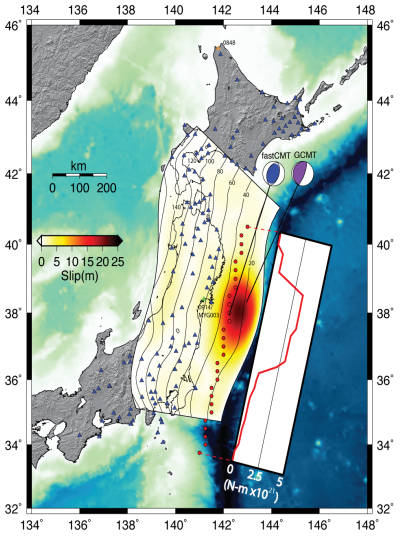
Objective

Develop real-time alert system and sensor web to accelerate early warnings for earthquakes, tsunamis and extreme storms and flooding events

- Develop power-efficient, low-cost, plug-in geodetic module as a prototype for the next-generation geodetic station, including GPS, accelerometer and meteorological sensors
- Enable generation of on-demand data products including millimeter-level displacements and precipitable water (PW) within the geodetic module
- In cooperation with NASA Applied Sciences Program, transfer capabilities to NOAA and California Integrated Seismic Network (CISN) for decision and rapid response to natural hazards emergencies



Centroid and Moment Tensor (CMT) and slip inversion results obtained within 3 minutes (order of magnitude faster than current state-of-the-art) for the 2011 Mw 9.0 Tokachi-oki earthquake using an optimal combination of GPS displacements and accelerometer data (see triangles for locations) in simulated real-time mode.

Red circles show extent of line source of CMT solutions, the final averaged solution shown as fastCMT, and Global CMT solution.

The inset shows the moment release from the line source of CMTs as a function of distance along fault. Shown along the fault interface with 20 km depth contours is the result of the slip inversion.

Approach

- Leverage existing real-time continuous GPS in Western North America and technology developments
  - SIO telemetry buffer for streaming high-rate GPS data
  - Real-time GPS Sensor Grid and GPS meteorology
  - Algorithms for optimal combination of GPS and strong-motion accelerometer data
- Manufacture geodetic module, build interface with new strong-motion accelerometer package and meteorological package
- Develop tightly-coupled Kalman filter to fuse raw GPS and accelerometer data and use precise point positioning approach to reduce dependence on stable reference

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Key Milestones

• Develop geodetic module, MEMS packages	12/12
• Upgrade 15 GPS stations	11/13
• Deploy Prototype Sensor Web	06/14
• Embed the Kalman filter in the geodetic module for output of displacements and PW	12/14
• Upgrade 15 additional GPS stations	12/14
• Infuse technology to NOAA (near-real-time PW)	06/15
• Prototype interactive display for precipitable water at NOAA Weather Forecasting Offices	12/15
• Integrate precipitable water prototype into AWIPS-II	06/16

$TRL_{in} = 4$ $TRL_{current} = 5$